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00  00  TT  SS  SS  PP  PP  00  00  WW  WW  CC  DD  DD  JJ
00  00  TT  SS  SS  PP  PP  00  00  WW  WW  CC  DD  DD  JJ
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000000  TT  SSSSSSSS  PP  000000  WW  WW  CCCCCCCC  DDDDDDDD  JJJJJJ
000000  TT  SSSSSSSS  PP  000000  WW  WW  CCCCCCCC  DDDDDDDD  JJJJJJ
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LL  IIIIII  SSSSSSSS
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LL  II  SSSSSS
LL  II  SSSSSS
LL  II  SS
LL  II  SS
LL  II  SS
LLLLLLLLLL  IIIIII  SSSSSSSS
LLLLLLLLLL  IIIIII  SSSSSSSS
```

(2)	47	HISTORY	: Detailed Current Edit History
(3)	56	DECLARATIONS	
(4)	90	OTSS\$POWCDJ_R3 - D COMPLEX*16 ** INTEGER*4	

```

0000 1      .TITLE  OTSSPOWCDJ - D COMPLEX*16 ** INTEGER*4 power routine
0000 2      .IDENT  /1-003/      ; File OTSPOWCDJ.MAR Edit: SBL1003
0000 3
0000 4      *****
0000 5      *
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0000 22     *  SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.
0000 23     *
0000 24     *
0000 25     *****
0000 26
0000 27
0000 28
0000 29     FACILITY: Language support library - user callable
0000 30     ++
0000 31     ABSTRACT:
0000 32
0000 33         D COMPLEX*16 base to INTEGER*4 power.
0000 34         Floating overflow can occur.
0000 35         Undefined exponentiation can occur if
0000 36         base = (0.,0.) and exp <=0
0000 37
0000 38     --
0000 39
0000 40     VERSION: 1
0000 41
0000 42     HISTORY:
0000 43     AUTHOR:
0000 44         Steven B. Lionel, 27-July-1979
0000 45

```



OTSSPOWCDJ  
1-003

J 9  
- D COMPLEX\*16 \*\* INTEGER\*4 power routin 16-SEP-1984 01:55:48 VAX/VMS Macro V04-00 Page 2  
HISTORY ; Detailed Current Edit History 6-SEP-1984 11:27:49 [MTHRTL.SRC]OTSSPOWCDJ.MAR;1 (2)

0000 47 .SBTTL HISTORY ; Detailed Current Edit History  
0000 48  
0000 49  
0000 50 : Edit History  
0000 51 : 1-001 - Adapted from OTSSPOWCDJ version 1-003. SBL 27-July-1979  
0000 52 : 1-002 - Correct bug in testing for undefined result with negative powers.  
0000 53 : SPR 11-35262 SBL 22-Jan-1981  
0000 54 : 1-003 - Use general mode addressing. SBL 30-Nov-1981

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0000 56          .SBTTL  DECLARATIONS
0000 57
0000 58 :
0000 59 : INCLUDE FILES:
0000 60 :
0000 61 :
0000 62 : EXTERNAL SYMBOLS:
0000 63 :
0000 64 :
0000 65          .DSABL  GBL
0000 66          .EXTRN  MTH$$SIGNAL          ; Math error routine
0000 67          .EXTRN  OTSS$DIVCD R3        ; COMPLEX division routine
0000 68          .EXTRN  MTH$K_UNDEXP
0000 69
0000 70 :
0000 71 : MACROS:
0000 72 :
0000 73 :
0000 74 :
0000 75 : EQUATED SYMBOLS:
0000 76 :
0000 77 :
0000 78 :
0000 79 : OWN STORAGE:
0000 80 :
0000 81 :
0000 82 :
0000 83 : PSECT DECLARATIONS:
0000 84 :
0000 85 :
0000 86          .PSECT  _OTSS$CODE PIC,SHR,LONG,EXE,NOWRT
0000 87          ; program section for OTSS$ code
0000 88

```

```

0000 90 .SBTTL OTSS$POWCDJ_R3 - D COMPLEX*16 ** INTEGER*4
0000 91 : **
0000 92 : FUNCTIONAL DESCRIPTION:
0000 93 :
0000 94 : D COMPLEX*16 result = D COMPLEX*16 base ** INTEGER*4 exponent
0000 95 : The COMPLEX result is given by:
0000 96 :
0000 97 : base          exponent          result
0000 98 :
0000 99 : any          >0          PRODUCT (base * 2**i) where
0000 100 :                               i is each non-zero bit in
0000 101 :                               exponent.
0000 102 :
0000 103 : (0., 0.)      <=0          Undefined exponentiation.
0000 104 :
0000 105 : not (0., 0.)  <0          PRODUCT (base * 2**i) where
0000 106 :                               i is each non-zero bit in
0000 107 :                               !exponent!.
0000 108 :
0000 109 : not (0., 0.)  =0          (1.0, 0.0)
0000 110 :
0000 111 : Floating overflow can occur.
0000 112 : Undefined exponentiation occurs if base is 0 and
0000 113 : exponent is 0 or negative.
0000 114 :
0000 115 : CALLING SEQUENCE:
0000 116 :
0000 117 : result.wdc.v = OTSS$POWCDJ_R3 (base.rdc.v, exponent.rl.v)
0000 118 :
0000 119 : INPUT PARAMETERS:
0000 120 : base = 4          : D COMPLEX*16 base passed by VALUE!
0000 121 : exponent = 20     : Longword integer exponent by value.
0000 122 :
0000 123 : IMPLICIT INPUTS:
0000 124 : NONE
0000 125 :
0000 126 : OUTPUT PARAMETERS:
0000 127 : NONE
0000 128 :
0000 129 : IMPLICIT OUTPUTS:
0000 130 : NONE
0000 131 :
0000 132 : FUNCTION VALUE:
0000 133 :
0000 134 : THE D COMPLEX*16 result is returned in registers R0-R3.
0000 135 : This is a violation of the VAX calling standard, but is
0000 136 : excused for compiled code support routines.
0000 137 :
0000 138 :
0000 139 : SIDE EFFECTS:
0000 140 :
0000 141 : Modifies registers R0-R3!
0000 142 : SS$ FLTOVF - Floating overflow
0000 143 : SIGNALs MTH$ UNDEXP (82 = ' UNDEFINED EXPONENTATION') if
0000 144 : base is 0 and exponent is 0 or negative.
0000 145 :
0000 146 : --

```

00000004  
00000014



```
01F0 0000 148 .ENTRY OTSSPOWCDJ_R3, ^M<R4,R5,R6,R7,R8>
      0002 149 ; disable integer overflow
      0002 150 ; R4-R7 gets COMPLEX base
54 04 AC 7D 0006 151 MOVQ base(AP), R4
56 0C AC 7D 0006 151 MOVQ base+8(AP), R6
58 14 AC D0 000A 152 MOVL exponent(AP), R8
      03 18 000E 153 ; R8 = longword exponent
      58 58 CE 0010 154 ; R8 = ! exponent !
      OF 58 00 E5 0013 155 1$: BBCC #0, R8, EVEN ; branch if even and clear low bit
      50 54 70 0017 156 MOVD R4, R0 ; R0-R3 = initial result
      52 56 70 001A 157 MOVD R6, R2
58 58 FF 8F 9C 001D 158 ROTL #-1, R8, R8 ; R8 = unsigned_exponent / 2
      5E 13 0022 159 BEQL DONE ; done if exponent was 1
      2D 11 0024 160 BRB SQUAR1 ; else use rest of exponent
      0026 161
      0026 162 EVEN: MOVD #1, R0 ; R0-R3 = initial result
      50 08 70 0026 163 CLRQ R2 ; (1.0, 0.0)
58 58 FF 8F 9C 002B 165 ROTL #-1, R8, R8 ; R8 = unsigned_exponent / 2
      21 12 0030 166 BNEQ SQUAR1 ; branch if exponent not 0
      54 73 0032 167 TSTD R4 ; exponent was 0, text RP(base)
      4C 12 0034 168 BNEQ DONE ; done if non-0, answer is 1.0
      56 73 0036 169 TSTD R6 ; IP(base) better not be zero
      48 12 0038 170 BNEQ DONE ; it isn't return 1.0
      003A 171
      003A 172 UNDEFINED:
      50 01 0F 79 003A 173 ASHQ #15, #1, R0 ; return R0-R3 = reserved operands
      52 01 0F 79 003E 174 ASHQ #15, #1, R2
      7E 00 8F 9A 0042 175 MOVZBL #MTH$K_UNDEXP, -(SP) ; FORTRAN error number
00000000'GF 01 FB 0046 176 CALLS #1, G^MTH$$$SIGNAL ; convert to 32-bit condition code
      04 004D 177 RET ; and SIGNAL MTH$_UNDEXP
      004E 178
      58 58 FF 8F 78 004E 180 SQUAR: ASHL #-1, R8, R8 ; R8 = !reduced exponent! / 2
      0053 181
      0053 182 ; R4-R7 = square current base
      0053 183
      0053 184
      0053 185 SQUAR1:
      7E 56 54 65 0053 186 MULD3 R4, R6, -(SP) ; (SP) = tmp = RP(base)*IP(base)
      54 54 64 0057 187 MULD2 R4, R4 ; R4-R5 = RP(base)**2
      56 56 64 005A 188 MULD2 R6, R6 ; R6-R7 = IP(base)**2
      54 56 62 005D 189 SUBD2 R6, R4 ; R4-R5 = RP(base)**2 - IP(base)**2
56 8E 6E 61 0060 190 ADDD3 (SP), (SP)+, R6 ; R6-R7 = 2*(RP(base)*IP(base))
      E7 58 E9 0064 191 BLBC R8, SQUAR ; branch if next exponent bit is 0
      0067 192
      0067 193 ; R0-R3 = partial result * current power of base
      0067 194
      7E 56 50 65 0067 195 MULD3 R0, R6, -(SP) ; (SP) = tmp = RP(part) * IP(base)
      50 54 64 006B 196 MULD2 R4, R0 ; R0-R1 = RP(part) * RP(base)
      7E 56 52 65 006E 197 MULD3 R2, R6, -(SP) ; (SP) = tmp = IP(part) * IP(base)
      50 8E 62 0072 198 SUBD2 (SP)+, R0 ; R0-R1 = RP(part)*RP(base)-IP(part)*IP(base)
      52 54 64 0075 199 MULD2 R4, R2 ; R2-R3 = IP(part)*RP(base)
      52 8E 60 0078 200 ADDD2 (SP)+, R2 ; R2-R3 = IP(part)*RP(base)+RP(part)*IP(base)
58 58 FF 8F 78 007B 201 ASHL #-1, R8, R8 ; R8 = !reduced exponent! / 2
      D1 12 0080 202 BNEQ SQUAR1 ; loop if more exponent bits left
      14 AC D5 0082 203 DONE: TSTL exponent(AP) ; test exponent sign
      0082 204
```



OTSSPOWCDJ  
1-003

N 9  
- D COMPLEX\*16 \*\* INTEGER\*4 power routin 16-SEP-1984 01:55:48 VAX/VMS Macro V04-00 Page 6  
OTSSPOWCDJ\_R3 - D COMPLEX\*16 \*\* INTEGER\* 6-SEP-1984 11:27:49 [MTHRTL.SRC]OTSPWCDJ.MAR;1 (5)

```

1A 18 0085 205 BGEQ POWCDJ ; done if positive
50 73 0087 206 TSTD R0 ; test RP(result)
04 12 0089 207 BNEQ RECIP ; if non-0, OK to take reciprocal
52 73 008B 208 TSTD R2 ; RP(result) was 0, test IP(result)
AB 13 008D 209 BEQL UNDEFINED ; undefined (0.0+0.0i) ** -n
      008F 210 RECIP:
7E 52 7D 008F 211 MOVQ R2, -(SP) ; second arg pair is divisor
7E 50 7D 0092 212 MOVQ R0, -(SP)
      7E 7C 0095 213 CLRQ -(SP) ; push (1.0,0.0) on stack
00000000'GF 08 70 0097 214 MOVD #1, -(SP)
      08 FB 009A 215 CALLS #8, G*OTSS$DIVCD_R3 ; R0-R3 = reciprocal
      00A1 216 POWCDJ:
      00A1 217 RET ; result in R0-R3
      00A2 218
      00A2 219 .END
```

OTSSPOWCDJ  
Symbol table

BASE	= 00000004		
DONE	00000082	R	01
EVEN	00000026	R	01
EXPONENT	= 00000014		
MTH\$SSIGNAL	*****	X	00
MTH\$K_UNDEXP	*****	X	00
OTSS\$DIVCD_R3	*****	X	00
OTSSPOWCDJ_R3	00000000	RG	01
POWCDJ	000000A1	R	01
RECIP	0000008F	R	01
SQUAR	0000004E	R	01
SQUAR1	00000053	R	01
UNDEFINED	0000003A	R	01

+-----+  
! Psect synopsis !  
+-----+

PSECT name	Allocation	PSECT No.	Attributes														
ABS	00000000 ( 0.)	00 ( 0.)	NOPIC	USR	CON	ABS	LCL	NOSHR	NOEXE	NORD	NOWRT	NOVEC	BYTE				
_OTSS\$CODE	000000A2 ( 162.)	01 ( 1.)	PIC	USR	CON	REL	LCL	SHR	EXE	RD	NOWRT	NOVEC	LONG				

+-----+  
! Performance indicators !  
+-----+

Phase	Page faults	CPU Time	Elapsed Time
-----	-----	-----	-----
Initialization	29	00:00:00.09	00:00:00.97
Command processing	124	00:00:00.45	00:00:02.59
Pass 1	76	00:00:00.60	00:00:01.93
Symbol table sort	0	00:00:00.00	00:00:00.04
Pass 2	53	00:00:00.48	00:00:01.53
Symbol table output	2	00:00:00.02	00:00:00.02
Psect synopsis output	2	00:00:00.01	00:00:00.02
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	288	00:00:01.65	00:00:07.10

The working set limit was 900 pages.  
3177 bytes (7 pages) of virtual memory were used to buffer the intermediate code.  
There were 10 pages of symbol table space allocated to hold 13 non-local and 1 local symbols.  
219 source lines were read in Pass 1, producing 11 object records in Pass 2.  
0 pages of virtual memory were used to define 0 macros.

+-----+  
! Macro library statistics !  
+-----+

Macro library name	Macros defined
-----	-----
_\$255\$DUA28:[SYSLIB]STARLET.MLB;2	0

0 GETS were required to define 0 macros.

There were no errors, warnings or information messages.

OTSSPOWCDJ  
VAX-11 Macro Run Statistics

- D COMPLEX\*16 \*\* INTEGER\*4 power routin 16-SEP-1984 01:55:48 VAX/VMS Macro V04-00 Page 8  
6-SEP-1984 11:27:49 [MTHRTL.SRC]OTSPOWCDJ.MAR;1 (5)

MACRO/ENABLE=SUPPRESSION/DISABLE=(GLOBAL,TRACEBACK)/LIS=LIS\$:OTSPOWCDJ/OBJ=OBJ\$:OTSPOWCDJ MSRC\$:OTSPOWCDJ/UPDATE=(ENH\$:OTSPOWCDJ)



0264 AH-BT13A-SE  
VAX/VMS V4.0

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